Using Technology To Teach Problem Solving Skills In Math

(More Reasons to Love Your ITS)
Maria Thomas
ITS
Norfolk Public Schools
21 years teaching experience as a high school math teacher

*NBCT in Adolescence and Young Adulthood Math

*Google certified educator
How much is the tip?

https://www.flickr.com/photos/vxla/6144158811

https://pxhere.com/en/photo/1028642
There's an app for that!

“Oh that's easy. I will just use my cellphone ...”
Who among you were taught to do it this way?

Calculating Sales Tax and Tip - Method One

Figure out your total bill, if you buy a CD for $15.50 with a sales tax of 5%.

Step One - Convert the percent to a decimal.

5% = .05

Step Two – Multiply the price and the decimal.

$15.50 \times .05 = .775 \text{ round to } .78$

Step Three - Add the tax or tip to the price.

$15.50 + .78 = $16.28$

https://www.slideshare.net/tigergirl823/sales-tax-and-tip-powerpoint
3 out of 24 students said,

“I will take 10% of the amount by moving the decimal point over to the left once, then double up that amount.”
“When we work on mathematics, even an abstract calculation, five brain areas are involved and two of them are visual pathways...”

- Dr. Jo Boaler, Professor of Mathematics Education, Stanford University
*Technology is changing so fast.

*Most of the mathematics students are learning now may no longer be relevant when they enter the workplace.

What this presentation is all about

“In the future, we know we will need people who can problem solve, think quantitatively about the world, and reason with their ideas.” - Dr. Jo Boaler

What this presentation is all about

- Most math classes are speed driven
- On the contrary, many mathematics students think slowly and deeply
- Teachers who take answers from first students who raise their hands send a message that SPEED is what is valued.
How do you set the pace of your classroom?

- Ask students to submit answers online, using Google Forms
- Refrain from using apps that show leader boards
- Encourage collaboration and effective differentiation. Set a reasonable time that will allow everyone to finish before you ask questions.
FORTUNE 500 MOST VALUED SKILLS

30 YEARS AGO
- Writing
- Computational Skills
- Reading Skills
- Oral communications
- Listening Skills
- Personal Development
- Creative Thinking
- Leadership
- Goal Setting/Motivation
- Teamwork
- Organizational Effectiveness
- Problem Solving
- Interpersonal Skills

10 YEARS AGO
- Teamwork
- Problem Solving
- Interpersonal Skills
- Oral communications
- Listening Skills
- Personal Development
- Creative Thinking
- Leadership
- Goal Setting/Motivation
- Writing
- Organizational Effectiveness
- Computational Skills
- Reading Skills
From the article:

5 interview questions that will help you hire better people

Resource:
https://ideas.ted.com/5-interview-questions-that-will-help-you-hire-better-people/
25 x 25
How would you **solve** this problem?
25 \times 25

\begin{align*}
.25 \times 2 &= .50 \\
.25 \times 20 &= 5.00 \\
.25 \times 5 &= 1.25 \\
\end{align*}

6.25

25 \times 25 = 625
The 4 steps of problem solving

1. **Understand the Problem**

*What do you have to find or show?

*Can you think of a picture or diagram that might help you understand the problem?

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George Polya - Mathematics, Statistics and Physics

Mathematics is the cheapest science. Unlike physics or chemistry, it does not require any expensive equipment. All one needs for mathematics is a pencil and paper.

https://www.azquotes.com/quote/572595

George Polya - Mathematics, Statistics and Physics
ONE  OR  TWO
WHAT'S THE FASTEST WAY FOR ALL SIX ANIMALS TO GET ACROSS?
1. The raft needs at least one animal to paddle it across the river, and it can hold at most two animals.

2. If the lions ever outnumber the wildebeest on either side of the river (including the animals in the boat if it’s on that side), they’ll eat the wildebeest.

3. The animals can’t just swim across, and there are no tricks; the animals have to use the boat as described.
2. Devise a plan

*According to George Polya, the skill for choosing the best strategy can be learned by solving many problems.

George Polya - Mathematics, Statistics and Physics
Your Strategies:

• Guess and check
• Make an orderly list
• Eliminate possibilities
• Use symmetry
• Consider special cases
• Use direct reasoning
• Solve an equation

• Look for a pattern
• Draw a picture
• Solve a simpler problem
• Use a model
• Work backwards
• Use a formula
• Be ingenious
3. Carry out the plan!

*According to Polya, persist with the plan, but if it continues not to work, discard and choose another.

George Polya – Mathematics, Statistics and Physics
Let's Workout the Riddle.

HINT:
Try sending two wildebeest first and check to see if this is a good first move.
10 minutes
The solution

Taken from:

https://www.youtube.com/watch?v=ADR7dUoVh_c&vl=en
Step 4: Look Back!

(Reflection Points)

- Look back and reflect on what you have done.
- What worked?
- What didn’t?
- Will your strategy still work if you have 4 lions and 4 wildebeest instead?

George Polya - Mathematics, Statistics and Physics
The Role of Technology Integration

- How does this activity make learning better?
- Are students more actively engaged in their learning?
- Is data collected to help you respond more quickly to student needs?
- How are students collaborating?
- How does this technology allow for developing critical thinking?
- How are interactions with students improved?

The following pictures of dots are meant to be used like flash cards. The teacher is suggested to show the picture for about 3 seconds, and cover it up (or make it disappear). The goal is to determine whether students are subitizing.
How many dots are there?
If the student’s counting strategy is not apparent, the teacher asks the student how he or she knew there were $n$ dots (where $n$ is the number the student reported).

But why do we limit the time to 3 seconds only? Is that a reasonable time? So if a student is unable to answer within that time frame, then they’re given more probing questions. Why can’t we do this for all students?

http://www.cpalms.org/Public/PreviewResourceAssessment/Preview/36561
Your strategies:

- Guess and check
- Make an orderly list
- Eliminate possibilities
- Use symmetry
- Consider special cases
- Use direct reasoning
- Solve an equation
- Look for a pattern
- Draw a picture
- Solve a simpler problem
- Use a model
- Work backwards
- Use a formula
- Be ingenious
Without counting... how can you tell how many dots there are?

Drag the dots to show your strategy. Describe it in the box to the right.
Strategy

Number
Strategy

Number

?
Create Your Own Challenges

Dots are placed “off canvas.” Drag dots onto the canvas for the following Slides. Share with a friend!
DIRECTIONS

Have students use grouping strategies for the dots. Students can drag the dots and then explain their strategy in the box to the right.

To critique the reasoning of others, have students share the Slides with a peer. Peers can insert comments about the strategy.
Strategy

Number

?
If the student's counting strategy is not apparent, the teachers asks the student how he or she knew there were $n$ dots (where $n$ is the number the student reported).
Making 10
For the first tab you will want to represent the number 10 as 2 colors. This is paint by number so you will type in a single digit number to choose a color. Fill in the grid.

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Using 2 colors only. Create an equation in the yellow box that makes ten? Match your model.

Type in 2 different numbers to create 2 colors

Check your answer in blue box.

=___+___
B. In the yellow box to the right, represent the EQUATION. For example $2 + 8 = 10$. In the blue box below it, you need to write a spreadsheet FORMULA to check your work. Always start with an equals sign. If you type $=2+8$ the spreadsheet should do the math for you and show the value is 10.
3 colors

Next tab

Type an equation in the yellow box to match your model:

\[ 6 + 2 + 2 = 10 \]

Check your answer in the blue box:

=___+___+___

Check!
LEAVES ON MY TREE
Leaves on My Tree

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<th>1 have</th>
<th>orange leaves.</th>
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How close to 100 game
Authorization Required

Make 100 needs your permission to access your data on Google.
Player One: In the sidebar, click the “Roll dice” button.
Place the array onto the board by typing in 1's. Represent the length and width of the rectangle visually.
Represent the array on the game board by typing in 2's.
*Click FINISH on the SlideShot Chrome extension
*Go through the slides and explain your thinking and your process. How did it go? REFLECT!
Investigating Area
Task

Create a non-simple polygon on your Geoboard App or website.
Shade in the area you are going to determine the area for. Now copy the diagram onto graph paper.

Subdivide your shaded polygon using Geoboard

Determine the area two different ways:
- Interior subdivisions
- Exterior subdivisions

After you are sure you have the correct area (both of your answers should agree). Give another person, not at your table, your diagram to determine the area. It will be returned to you for you to evaluate.
Exterior Calculation

For the shaded area’s calculation, you will take the area of the rectangle minus the 5 regions.
EXTERIOR CALCULATION

For the shaded area’s calculation, you will take the area of the rectangle minus the sum of the 5 regions.

Region 1, a trapezoid. Base 1 is 3 units, Base 2 is 12 units, height is 1. The area is \( \frac{1}{2} \times (3 + 12) = 7.5 \) sq units.

Region 2, a trapezoid. Bases are 3 and 7 units, height of 4 units. Area is \( \frac{1}{2}(3+7)(4) = 20 \) sq. units.

Region 5, a right triangle with height of 1 and a base of 5, so the area is \( \frac{1}{2} \times 5 \times 1 = 2.5 \) sq units.

Regions 3 & 4 make a rectangle that is 1 by 7, so the area is 7 sq units.
Region 1 is a right triangle with a height of 1 and a length of 9. Its area is $\frac{9}{2}$ or 4.5 sq units.

Region 2 is a right triangle with a height and base of 4. Its area is 8 sq units.

Region 3 is a trapezoid with a height of 1 and bases of 5 and 12. Its area is $\frac{1}{2}(5+12) = \frac{17}{2}$ sq units.

Region 4 is a triangle with a height of 1 and a base of 12. Its area is 6 sq units.

Region 5 is a rectangle with sides of 4 and 5 units. Its area is 20 sq units.

The area of the polygon is the sum of all 5 regions.
Slide Shot Chrome Extension

SlideShot creates a screenshot every minute (or you can do it manually) and saves the image in Google Drive.

Students are able to use this Chrome extension to create a presentation of their work while utilizing web tools. Each slide has room for students to add a text box to explain their thinking and learning.
How would you stop the bomb from detonating?
Decanting puzzle

https://goo.gl/YydyCq
To Recap:

To teach students how to solve real life problems:

- Give students time to think. Math is not about speed.
- Visuals are vital to effective problem solving.
- Provide a list of viable strategies
- Challenge their creativity
- Use non cookie cutter problems instead of traditional textbook ones
- Get help from your ITS/ITRT
It's a wrap!
Thank you!
Resources:

The activities provided on slides 33–39, 40–43, 44–46 and 47–52 have all been taken from the book “Teaching Math With Google Apps” by Alice Keeler and Diana Herrington. Copies of the book can be obtained from Amazon and Dave Burgess Consulting.


Slide 13 –
https://ideas.ted.com/5-interview-questions-that-will-help-you-hire-better-people/

Slide 17–19, 26 –
https://www.youtube.com/watch?v=ADR7dUoVh_c&vl=en

Slide 33 – 39 –
Resources:


Slides 58 and 60 – https://www.youtube.com/watch?v=6cAbgAaEOVE
SPECIAL THANKS

Vic Yap for the avatars

Mr. Yap is a graduate of the University of the Philippines, with a bachelor’s degree in Fine Arts, major in Painting.

Email: vicente.yap@gmail.com

Phone: (757) 295–1442